

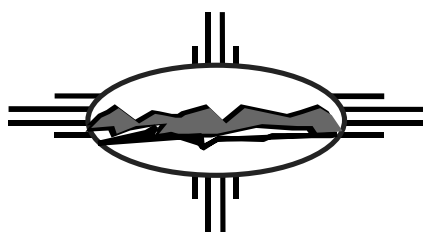
STANDARD OPERATING PROCEDURE

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Groundwater Samples**

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ER PROJECT

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LOS ALAMOS NATIONAL LABORATORY

Field Analytical Measurements of Groundwater Samples

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Field Analytical Measurements of Groundwater Samples

NOTE: Environmental Restoration (ER) Project personnel may produce copies of this procedure from the controlled document electronic file. However, it is their responsibility to ensure that they are trained on and utilizing the current version of this procedure. The procedure author may be contacted if text is unclear.

1.0 PURPOSE

This Standard Operating Procedure (SOP) describes acceptable methods for obtaining field measurements of the temperature, specific conductance, pH, alkalinity, dissolved oxygen, and turbidity of groundwater that closely represent the conditions that exist in the aquifers for the ER Project.

2.0 TRAINING

The **Field Team Leader** (FTL) is responsible for ensuring that field team members who collect samples for the ER Project are trained in the operation and calibration of the field analytical equipment. In addition all field team members who use this procedure must document that they have read and understand this procedure in accordance with QP-2.2.

3.0 DEFINITIONS

- 3.1 Alkalinity — Various soluble mineral salts are found in natural water and arid soils that have a pH greater than 7. In water analysis alkalinity indicates the presence of carbonates, bicarbonates, and/or hydroxides, and occasionally the borates, chlorates, silicates, or phosphates.
- 3.2 Dissolved oxygen — The amount of oxygen dissolved in water, in parts per million (ppm) by weight or in milligrams per liter (mg/l).
- 3.3 Hydrogen-ion activity (pH) — The effective concentration (activity) of dissociated hydrogen ions [H+]. A measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with alkalinity and decreasing as acidity increases.
- 3.4 Site-Specific Health and Safety Plan (SSHASP)—A health and safety plan that is specific to a site or ER-related field activity that has been approved by an ER health and safety representative. This document contains information specific to the project including scope of work, relevant history, descriptions of hazards by activity associated with the project site(s), and

techniques for exposure mitigation (e.g., personal protective equipment [PPE]) and hazard mitigation.

- 3.5 Specific (electrical) conductance — A measure of the ease with which an applied electric field can flow through a material. It is dependant upon the presence of ions (total and relative concentrations, valence, and mobility) and temperature. It is the reciprocal of resistivity and is measured in either siemens (S) or micro-ohms per centimeter ($\mu\text{ohm}/\text{cm}$) at 25°C.
- 3.6 Turbidity (nephelometric) — A measure of the intensity of light scattered by sample particulates relative to a standard reference suspension. The range of water turbidity is measured from 0 to 40 nephelometric turbidity units (NTU). Five NTU or below is the sample acceptance criteria set by the US Environmental Protection Agency (EPA) (EPA, 1986).

4.0 BACKGROUND AND PRECAUTIONS

Note: This SOP is to be used in conjunction with an approved SSHASP. Also, consult the SSHASP for information on and use of all PPE.

- 4.1 Field analytical parameters are normally measured at the time of well-purging and groundwater-sampling activities. Measurements of temperature, turbidity, specific conductance, and pH, done in advance of sampling, are also used as the final indication that a well is purged of stagnant water. The alkalinity and dissolved oxygen of groundwater are highly dependent on the availability and partial pressures of carbon dioxide and oxygen in the underground environment. Preservation of samples selected for turbidity analyses is not practical. Because the value of these parameters begins to change with prolonged exposure to atmospheric conditions, wellhead measurements generally yield the most accurate representation of in situ values.
- 4.2 This procedure is to be used in conjunction with ER-SOP-6.01 and ER-SOP-6.04.
- 4.3 All waste generated from well development must be handled in accordance with ER-SOP-1.06.

5.0 EQUIPMENT

Suggested equipment and supplies used to implement this procedure are listed in Attachment A.

6.0 PROCEDURE

Note: Deviations from SOPs are made in accordance with QP-4.2.

For quality control, field measurements should be repeated, from the beginning, on the same samples that are selected for lab replicates. Follow instructions in the site-specific Sampling and Analysis Plan (SAP) for types and numbers of samples to be taken for quality control.

6.1 Preoperation Activities

- 6.1.1 Assemble the equipment (and the manufacturer's operator's manuals) and supplies suggested in Attachment A.
- 6.1.2 Verify that the equipment and meters are in good working order. The meters should not be dirty or have crusted material on the probes, and the batteries should be charged.

6.2 Use of Meters

This section contains general instructions on the use of temperature, conductivity, pH, dissolved-oxygen, and turbidity meters. Because there are several types of meters, refer to the operator's manual for specific instructions on the particular instrument being used.

6.2.1 Temperature

- 6.2.1.1 Calibrate an immersion thermometer or thermocouple by comparing its readings with those of the reference thermometer at two different temperatures that bracket the temperature range normally measured in the field. Calibration must be done at least annually and whenever the instrument is suspected of having been misused, been damaged, or producing erratic or erroneous readings. The instrument should be within $\pm 1.0^{\circ}\text{C}$ compared with a thermometer calibrated to the National Institute of Standards and Technology standards.
- 6.2.1.2 Obtain a representative groundwater sample as specified in ER-SOP-6.01 and ER-SOP-6.04.
- 6.2.1.3 Place the temperature probe into the groundwater sample, read the temperature upon stabilization, and record (see Section 6.3).
- 6.2.1.4 Some pH and conductivity meters are equipped with a temperature probe, which can be used to simultaneously measure sample temperature.

6.2.2 Specific (Electrical) Conductance

- 6.2.2.1 Use a specific-conductance meter that is battery operated, equipped with a temperature compensator, and reads directly in $\mu\text{ohm}/\text{cm}$ at 25°C . This type of meter will save time in converting resistance values to specific conductance and will ensure that the value is read in the field.
- 6.2.2.2 Use certified calibration standards to calibrate the conductivity meter. Commercially available standards come in 1,000, 10,000, 50,000, and 100,000 $\mu\text{ohm}/\text{cm}$ solutions. Use two standard solutions that are within an order of magnitude of the expected sample value.
- 6.2.2.3 Turn on the meter and adjust the conductivity range selector to the appropriate setting. Rinse the conductivity probe with deionized water and then measure the conductivity of the standard solution.
- 6.2.2.4 If the meter auto-calibrates, read the conductivity immediately upon stabilization and record (see Section 6.3). If the meter requires manual calibration, enter the appropriate solution value.
- 6.2.2.5 Obtain a representative groundwater sample as specified in ER-SOP-6.01 and ER-SOP-6.04.
- 6.2.2.6 Rinse the probe with deionized water, return the meter to measure mode, immerse the probe in the groundwater sample, and record the reading (see Section 6.3).

6.2.3 Hydrogen-Ion Activity (pH)

- 6.2.3.1 At least two pH standards are required to calibrate a pH meter. Standard solutions for pH meters are available in 4.01, 7.0, and 10.01 buffer solutions. Choose two standards that will bracket the expected pH value. Check the expiration dates on the buffer solutions to verify that the buffer solutions are still valid for equipment calibration.
- 6.2.3.2 Place the electrode into the first buffer and press the calibrate button. After the reading has stabilized, record the value (see Section 6.3). Rinse electrode with deionized water and place it into the second buffer, press the calibrate button and record the value. If the meter

requires manual calibration, manually enter the buffer value.

6.2.3.3 Obtain a representative groundwater sample as specified in ER-SOP-6.01 and ER-SOP-6.04.

6.2.3.4 Return the meter to measure mode, rinse the electrode with deionized water, and place it into the groundwater sample. Wait for a stable reading and then record the reading (see Section 6.3).

6.2.4 Dissolved Oxygen

6.2.4.1 Most dissolved-oxygen meters may be auto-calibrated on site by simply exposing the probe to saturated air and pressing the calibration button.

6.2.4.2 Obtain a representative groundwater sample as specified in ER-SOP-6.01 and ER-SOP-6.04.

6.2.4.3 Place the dissolved-oxygen probe into the groundwater sample and record the final value of dissolved-oxygen concentration to the nearest 0.1 mg/l (see Section 6.3).

6.2.5 Turbidity

6.2.5.1 Use Hach Model 2100 or 2100A or an acceptable equivalent that is capable of turbidity measurements (nephelometric) in conformance with EPA's Method 180.1 (EPA, 1983).

6.2.5.2 Most turbidimeters are precalibrated and need a zero adjustment before being used for testing. To zero a turbidimeter, place a vial with a solution of 0 NTU into the sample chamber and press the zero button. The solution can be either purchased or produced with deionized water and a filter system.

6.2.5.3 Obtain a representative groundwater sample as specified in ER-SOP-6.01 and ER-SOP-6.04.

6.2.5.4 Fill a vial with the recommended amount of groundwater sample. To get accurate results, the vial must be clean and free of defects. Discard any vials with scratches. Wipe the vial clean with lint-free tissues before inserting it into the chamber (it is important to keep the vials clean). To avoid smudges, handle each vial by its top rim only. Record the results of turbidity testing on the appropriate form (see Section 6.3).

6.3 Documentation

Document all information as indicated in ER-SOP-1.04. Information should be recorded in either field notebooks or Daily Activity Log forms (Attachment E in ER-SOP 1.04) and on the Water Quality Sampling Record (Attachment B in ER-SOP-6.01) and also, if needed, on the Water Quality Stabilization Record (Attachment B—form and completion instructions). Information that should be recorded includes the

- expiration date of calibration solution,
- lot number of calibration solution,
- manufacturer of calibration solution,
- date and time of calibration,
- results of calibration,
- date and time of each sample reading, and
- sample readings.

6.4 Postoperation Activities

6.4.1 When the sampling is completed, or at the end of the field day, carefully clean the outside of the sampling instruments with a damp disposable towel to remove any visible dirt. Clean and decontaminate the equipment as specified in ER-SOP-1.08 and replenish supplies.

6.4.2 Restore the site to the presampling conditions as described in the site-specific documents.

6.4.3 Return the equipment to the equipment manager. Report any malfunctions, performance deviations, or damage.

7.0 REFERENCES

The following documents have been cited within this procedure.

QP-2.2, Personnel Orientation and Training

QP-4.2, Standard Operating Procedure Development

QP-4.3, Records Management

ER-SOP-1.04, Sample Control and Field Documentation

ER-SOP-1.06, Management of Environmental Restoration Project Wastes

ER-SOP-1.08, Field Decontamination of Drilling and Sampling Equipment

ER-SOP-6.01, Purging of Well for Representative Sampling of Groundwater

ER-SOP-6.04, Sampling Commercial, Municipal, Domestic, and Monitoring Wells

EPA, "Methods for Chemical Analysis of Water and Wastes," EPA-600-4-79-020, Environmental Monitoring and Support Laboratory, (Office of Research and Development, Cincinnati, Ohio, March 1983).

EPA, "RCRA Groundwater Monitoring Technical Enforcement Guidance Document," (OSWER, U.S. Government Printing Office, Washington, D.C., 1986).

8.0 RECORDS

The **FTL** or designee is responsible for submitting the following records (processed in accordance with QP-4.3) to the Records Processing Facility.

- 8.1 Water Quality Sampling Record form (Attachment B in ER-SOP-6.01)
- 8.2 Water Quality Stabilization Record form (Attachment B)
- 8.3 Daily Activity Log form (Attachment E in ER-SOP 1.04) or field notebook

9.0 ATTACHMENTS

The document user may employ documentation formats different from those attached to/named in this procedure—as long as the substituted formats in use provide, as a minimum, the information required in the official forms developed by the procedure.

Attachment A: Equipment and Supplies Checklist for Field Analytical Measurements of Groundwater Samples (1 page)

Attachment B: Water Quality Stabilization Record (form and completion instructions) (2 pages)

Equipment and Supplies Checklist for Field Analytical Measurements of Groundwater Samples

For Temperature (one of the following)

- ☐ Calibrated, partial-immersion thermometer graduated in 0.5°C within the range of 0–50°C and the manufacturer's operating manual
- or
- ☐ A thermocouple calibrated within $\pm 0.5^\circ\text{C}$ greater than the range 0–50°C or expected use and the manufacturer's operating manual
- or
- ☐ The built-in thermometer in the pH or conductivity meter

For Specific Conductance

- ☐ Specific-conductance meter and the manufacturer's operating manual
- ☐ Calibration solutions

For pH

- ☐ pH meter and manufacturer's operating manual
- ☐ Standard pH solutions

For Dissolved Oxygen

- ☐ Oxygen meter with sensor and manufacturer's operating manual

For Turbidity

- ☐ Turbidity meter with a range of 0–40 NTU and manufacturer's operating manual

Forms

- ☐ Water Quality Sampling Record
- ☐ Water Quality Stabilization Record
- ☐ Daily Activity Log forms or field notebook

Other

- ☐ Any additional supplies listed in associated procedures, as needed
- ☐ Any PPE listed or required in the SSHASP

ER-SOP-6.02

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Water Quality Stabilization Record Completion

Header Information:

1. Date—Date of sampling.
2. Sheet Number—Number all the sheets that are used for this activity, by day or by some practical unit.
3. Technical Area (TA)—Two-digit number which indicates the TA in which the activity is being performed.
4. Focus Area—Focus Area in which the activity is being performed.
5. Site Work Plan—Title of plan.
6. Field Team Member Identification—Print your name and position title, then sign.

Time:

The time when a field measurement of purged water was performed in the format HH:MM.

Total Volume Withdrawn:

Using a bucket or flowmeter, the field team member will note the number of gallons of water purged from the well at the time that a field measurement is taken. This entry is cumulative and represents the total volume of water purged before sampling may begin.

A second column is provided so that the field team member can equate gallons to bore volumes purged (see equation on page 1 of the Water Quality Sampling Record—Attachment B in ER-SOP-6.01).

Parameter Measurements (Record each time a field measurement of purged water is performed.):

1. Potential of Hydrogen-Ion Activity—The pH units of the sample.
2. Specific Conductance—The specific conductance of the water in micro-ohms per centimeter in ($\mu\text{ohm}/\text{cm}$) at 25°C.
3. Temperature—The temperature of the water in degrees Celsius (°C).
4. Dissolved Oxygen—The dissolved oxygen content of the water in milligrams per liter (mg/l).
5. Turbidity—The turbidity of the water in nephelometric turbidity units (NTU).

Comments:

Note any other pertinent information. This section may be used to record alkalinity values.